

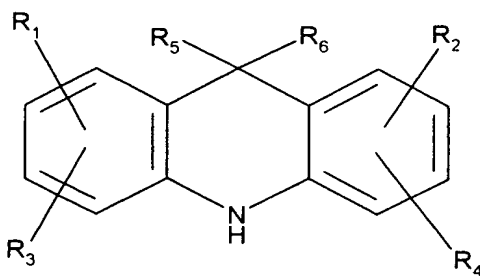
CLAIMS

What is claimed is:

1. A composition comprising:

A) a lubricant; and

B) a mixture of antioxidants, wherein said mixture is prepared by the partial condensation of an alkylated diphenylamine with an aldehyde or ketone in the presence of an acidic catalyst to yield at least one acridan of the general formula:



wherein:

R₁, R₂, R₃, and R₄ are independently selected from the group consisting of hydrogen, C₃ to C₃₂ alkyl, and C₃ to C₃₂ alkenyl, provided that at least one of R₁, R₂, R₃, and R₄ is not hydrogen, and R₅ and R₆ are independently selected from the group consisting of C₁ to C₂₀ hydrocarbyl and hydrogen;

wherein, at the termination of said condensation, residual alkylated diphenylamine is not separated from the acridan product.

2. The composition of claim 1 wherein the alkylated diphenylamine is selected from the group consisting of mono-, di-, and tri-nonylated diphenylamine and butylated octylated diphenylamine.

0174-PA

1 3. The composition of claim 1 wherein the alkylated diphenylamine is condensed with a
2 ketone.

1 4. The composition of claim 3 wherein the ketone is acetone.

1 5. The composition of claim 2 wherein the alkylated diphenylamine is condensed with a
2 ketone.

1 6. The composition of claim 5 wherein the ketone is acetone.

1 7. The composition of claim 1 wherein the composition further comprises at least one
2 antioxidant in addition to that provided by the mixture.

1 8. The composition of claim 7 wherein the additional antioxidant is selected from the
2 group consisting of amine antioxidants, hindered phenol antioxidants, and mixtures thereof.

1 9. The composition of claim 8 wherein the hindered phenol antioxidant is selected from
2 the group consisting of 2,4-dimethyl-6-octyl-phenol; 2,6-di-t-butyl-4-methyl phenol; 2,6-di-t-
3 butyl-4-ethyl phenol; 2,6-di-t-butyl-4-n-butyl phenol; 2,2'-methylenebis(4-methyl-6-t-butyl
4 phenol); 2,2'-methylenebis(4-ethyl-6-t-butyl-phenol); 2,4-dimethyl-6-t-butyl phenol; 4-
5 hydroxymethyl-2,6-di-t-butyl phenol; n-octadecyl-beta(3,5-di-t-butyl-4-
6 hydroxyphenyl)propionate; 2,6-dioctadecyl-4-methyl phenol; 2,4,6-trimethyl phenol; 2,4,6-
7 triisopropyl phenol; 2,4,6-tri-t-butyl phenol; 2-t-butyl-4,6-dimethyl phenol; 2,6-methyl-4-

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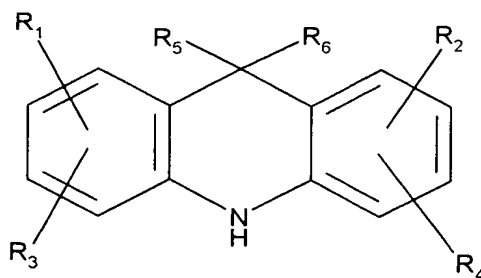
8 didodecyl phenol; tris(3,5-di-t-butyl-4-hydroxy isocyanurate; tris(2-methyl-4-hydroxy-5-t-
9 butylphenyl)butane; 3,5-di-t-butyl-4-hydroxy hydrocinnamate; octadecyl-3,5-di-t-butyl-4-
10 hydroxy hydrocinnamate; tetrakis{methylene(3,5-di-t-butyl-4-hydroxy-
11 hydrocinnamate)}methane; 1,2-bis(3,5-di-t-butyl-4-hydroxyhydrocinnamoyl)hydrazine;
12 1,3,5-tris(3,5-di-t-butyl-4-hydroxybenzyl)-s-triazine-2,4,6 (1H,3H,5H)trione; 2,2'-oxamido
13 bis-{ethyl-3-(3,5-di-t-butyl-4-hydroxyphenyl)}propionate; 1,3,5-tris(4-t-butyl-3-hydroxy-
14 2,6-dimethylbenzyl)-s-triazine-2,4,6-(1H,3H,5H)trione; 1,3,5-trimethyl-2,4,6-tris(3,5-di-t-
15 butyl-4-hydroxybenzyl)benzene; 3,5-di-t-butyl-4-hydroxyhydrocinnamic acid triester with
16 1,3,5-tris(2-hydroxyethyl)-5-triazine-2,4,6(1H,3H,5H)-trione; bis(3,3-bis(4-hydroxy-3-t-
17 butylphenyl)butanoic acid)glycolester; tetrakis{methylene (3,5-di-t-butyl-4-hydroxy-
18 hydrocinnamate)}methane; 1,3,5-trimethyl-2,4,6-tris(3,5-di-t-butyl-4-
19 hydroxybenzyl)benzene; and 3,5-di-t-butyl-4-hydroxy-hydrocinnamic acid C₇-C₉ branched
20 alkyl ester.

1 10. A composition comprising:

2 A) a lubricant; and

3 B) a mixture of antioxidants comprising:

4 1) at least one acridan of the general formula:



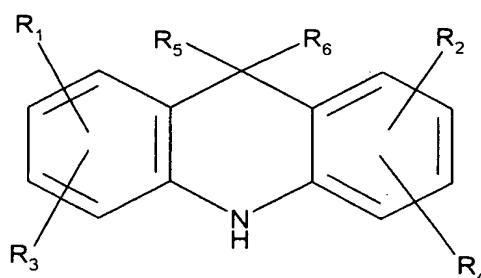
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wherein:

R_1 , R_2 , R_3 , and R_4 are independently selected from the group consisting of hydrogen, C_3 to C_{32} alkyl, and C_3 to C_{32} alkenyl, provided that at least one of R_1 , R_2 , R_3 , and R_4 is not hydrogen, and R_5 and R_6 are independently selected from the group consisting of C_1 to C_{20} hydrocarbyl and hydrogen

- 2) residual alkylated diphenylamine from the preparation of the acridan;
- 3) at least one additional antioxidant selected from the group consisting of amine antioxidants, hindered phenol antioxidants, and mixtures thereof.

11. A method for reducing the susceptibility of a lubricant to oxidation comprising adding to said lubricant a mixture of antioxidants, wherein said mixture is prepared by the partial condensation of an alkylated diphenylamine with an aldehyde or ketone in the presence of an acidic catalyst to yield at least one acridan of the general formula:



wherein:

R_1 , R_2 , R_3 , and R_4 are independently selected from the group consisting of hydrogen, C_3 to C_{32} alkyl, and C_3 to C_{32} alkenyl, provided that at least one of R_1 , R_2 , R_3 , and R_4 is not hydrogen, and R_5 and R_6 are independently selected from the group consisting of C_1 to C_{20} hydrocarbyl and hydrogen;

0174-PA

15 wherein, at the termination of said condensation, residual alkylated diphenylamine is not
16 separated from the acridan product.

1 12. The method of claim 11 wherein the alkylated diphenylamine is selected from the
2 group consisting of mono-, di-, and tri-nonylated diphenylamine and butylated octylated
3 diphenylamine.

1 13. The method of claim 11 wherein the alkylated diphenylamine is condensed with a
2 ketone.

1 14. The method of claim 13 wherein the ketone is acetone.

1 15. The method of claim 12 wherein the alkylated diphenylamine is condensed with a
2 ketone.

1 16. The method of claim 15 wherein the ketone is acetone.

1 17. The method of claim 11 wherein the composition further comprises at least one
2 antioxidant in addition to that provided by the mixture.

1 18. The method of claim 17 wherein the additional antioxidant is selected from the group
2 consisting of amine antioxidants, hindered phenol antioxidants, and mixtures thereof.

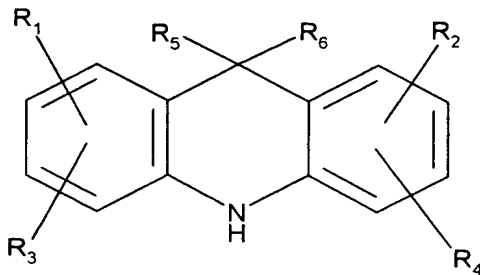
0174-PA

19. The method of claim 18 wherein the hindered phenol antioxidant is selected from the group consisting of 2,4-dimethyl-6-octyl-phenol; 2,6-di-t-butyl-4-methyl phenol; 2,6-di-t-butyl-4-ethyl phenol; 2,6-di-t-butyl-4-n-butyl phenol; 2,2'-methylenebis(4-methyl-6-t-butyl phenol); 2,2'-methylenebis(4-ethyl-6-t-butyl-phenol); 2,4-dimethyl-6-t-butyl phenol; 4-hydroxymethyl-2,6-di-t-butyl phenol; n-octadecyl-beta(3,5-di-t-butyl-4-hydroxyphenyl)propionate; 2,6-dioctadecyl-4-methyl phenol; 2,4,6-trimethyl phenol; 2,4,6-triisopropyl phenol; 2,4,6-tri-t-butyl phenol; 2-t-butyl-4,6-dimethyl phenol; 2,6-methyl-4-didodecyl phenol; tris(3,5-di-t-butyl-4-hydroxy isocyanurate; tris(2-methyl-4-hydroxy-5-t-butylphenyl)butane; 3,5-di-t-butyl-4-hydroxy hydrocinnamate; octadecyl-3,5-di-t-butyl-4-hydroxy hydrocinnamate; tetrakis{methylene(3,5-di-t-butyl-4-hydroxyhydrocinnamate)}methane; 1,2-bis(3,5-di-t-butyl-4-hydroxyhydrocinnamoyl)hydrazine; 1,3,5-tris(3,5-di-t-butyl-4-hydroxybenzyl)-s-triazine-2,4,6 (1H,3H,5H)trione; 2,2'-oxamido bis-{ethyl-3-(3,5-di-t-butyl-4-hydroxyphenyl)}propionate; 1,3,5-tris(4-t-butyl-3-hydroxy-2,6-dimethylbenzyl)-s-triazine-2,4,6-(1H,3H,5H)trione; 1,3,5-trimethyl-2,4,6-tris(3,5-di-t-butyl-4-hydroxybenzyl)benzene; 3,5-di-t-butyl-4-hydroxyhydrocinnamic acid triester with 1,3,5-tris(2-hydroxyethyl)-5-triazine-2,4,6(1H,3H,5H)-trione; bis(3,3-bis(4-hydroxy-3-t-butylphenyl)butanoic acid)glycolester; tetrakis{methylene (3,5-di-t-butyl-4-hydroxyhydrocinnamate)}methane; 1,3,5-trimethyl-2,4,6-tris(3,5-di-t-butyl-4-hydroxybenzyl)benzene; and 3,5-di-t-butyl-4-hydroxyhydrocinnamic acid C₇-C₉ branched alkyl ester.

0174-PA

20. A method for reducing the susceptibility of a lubricant to oxidation comprising adding to said lubricant a mixture of antioxidants, wherein said mixture comprises:

A) at least one acridan of the general formula:



wherein:

R₁, R₂, R₃, and R₄ are independently selected from the group consisting of hydrogen, C₃ to C₃₂ alkyl, and C₃ to C₃₂ alkenyl, provided that at least one of R₁, R₂, R₃, and R₄ is not hydrogen, and R₅ and R₆ are independently selected from the group consisting of C₁ to C₂₀ hydrocarbyl and hydrogen

B) residual alkylated diphenylamine from the preparation of the acridan;

C) at least one additional antioxidant selected from the group consisting of amine antioxidants, hindered phenol antioxidants, and mixtures thereof.